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Notice of Allowability

Application No.

10/789,661

Applicant(s)

HUANG, XIAOHUA

Examiner

Jung (John) Hur

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to Amendment, filed 14 March 2005.
2. ☒ The allowed claim(s) is/are 1-9.
3. ☒ The drawings filed on 27 February 2004 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date 20050414.
7. ☒ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____

Anh Phung
ANH PHUNG
PRIMARY EXAMINER

DETAILED ACTION

Amendment

1. Acknowledgment is made of applicant's Amendment, filed 14 March 2005. The changes and remarks disclosed therein were considered.

No claims have been cancelled or added. Therefore, claims 1-9 are pending in the application.

EXAMINER'S AMENDMENT

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

3. Authorization for this examiner's amendment was given in a telephone interview with Mr. Xiaohua Huang, on 14 April 2005 and 15 April 2005.

4. The application has been amended as follows:

Replace all the claims with the following (this includes renumbering of claims 8 and 9 to conform with 37 CFR 1.126):

--1. A ternary content addressable memory (TCAM) comprising:

an array of TCAM cells arranged in a plurality of rows and a plurality of columns;

a plurality of match lines, one match line for each row of TCAM cells and operatively coupled to a plurality of output transistors for the TCAM cells in each row;

a plurality of dummy lines, one dummy line for each row of TCAM cells and operatively coupled to a plurality of dummy transistors for the TCAM cells in each row;

a plurality of match data bit lines and their complements, one pair of match data bit line and its complement for each column of TCAM cells to provide a match data and its complement to compare with the content stored in each TCAM cell of that column;

a column of dummy TCAM (DTCAM) cells, each connected to the match line and the dummy line in each row;

a pair of dummy match data bit line and its complement for the column of DTCAM cells to provide a dummy match data and its complement to compare with the content stored in each DTCAM cell;

a sense amplifier connected to the match line and the dummy line in each row; and
current sources connected to each of the match line and the dummy line in each row.

2. The TCAM of claim 1, wherein each TCAM cell comprises:

a memory cell operable to store a data bit value;

a secondary cell operable to store a control bit value; and

a comparison circuit coupled to the memory cell and the secondary cell and configured to detect the data bit value stored in the memory cell and the control bit value stored in the secondary cell, the comparison circuit including:

a pair of output transistors coupled to the corresponding match line and configured to provide a drive for the match line based on the detected data bit value and the detected control bit value; and

a pair of dummy transistors coupled to the corresponding dummy line to provide a drive for the dummy line based on the detected control bit value, wherein the match line and the dummy line are used to detect an output value provided by the TCAM cell.

3. The TCAM of claim 1, wherein each DTCAM cell comprises:

a memory cell operable to store a data bit value;

a secondary cell operable to store a control bit value; and

a comparison circuit coupled to the memory cell and the secondary cell and configured to detect the data bit value stored in the memory cell and the control bit value stored in the secondary cell, the comparison circuit including:

a pair of output transistors coupled to the corresponding match line and configured to provide a drive for the match line based on the detected data bit value and the detected control bit value; and

a pair of dummy transistors coupled to the corresponding dummy line and configured to provide a drive for the dummy line based on the detected inverted data bit value and the detected control bit value.

4. The TCAM of claim 3, wherein the dummy transistors have smaller dimension and less driving ability than the output transistors, are located in close proximity to the output

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transistors, and are turned ON during sensing operation to enable the comparison of the corresponding row.

5. The TCAM of claim 3, wherein the dummy transistors are turned OFF and the output transistors are turned ON during sensing operation to disable the comparison of the corresponding row.

6. The TCAM of claim 1, wherein the sense amplifier connected to the match line and the dummy line in each row comprises:

two inverters connected to each other in a way of positive feedback; and

a P type transistor serially connected to both inverters and Vdd.

7. The TCAM of claim 1, wherein the current sources connected to each of the match line and the dummy line in each row are P type transistors to provide currents from Vdd to the match line and the dummy line.

8. A method of detecting a match or a mismatch state of a comparison result in each row of a ternary content addressable memory (TCAM) having an array of TCAM cells arranged in rows and columns, a plurality of match lines and dummy lines, one match line and one dummy line coupled to the TCAM cells in each row, a plurality of match data bit lines and their complements, one pair of match data bit line and its complement coupled to the TCAM cells in each column, a column of dummy TCAM (DTCAM) cells, each coupled to the match line and

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the dummy line in each row, a pair of dummy match data bit line and its complement coupled to the DTCAM cells, a sense amplifier coupled to the match line and the dummy line in each row, current sources connected between Vdd and each of the match line and the dummy line in each row, and switches connected between ground and each of the match line and the dummy line, the method comprising:

- disabling the current sources such that there is no current flowing from Vdd to the match line and the dummy line;

- disabling the sense amplifier;

- enabling the switches to establish conducting paths from the match line and the dummy line to ground to make the potential of the match line and the dummy line equal to the ground voltage potential and discharge the match line and the dummy line to ground;

- disabling the switch to shut off conducting paths from the match line and the dummy line to ground after the voltage potentials of both the match line and the dummy line are equal to the ground voltage potential;

- sending a plurality of match data and their complements to the TCAM cells through the corresponding match bit lines and their complements to compare with the content stored in the corresponding TCAM cells;

- sending a dummy match data and its complement to the DTCAM cell through the dummy match data bit line and its complement to compare with the content stored in the DTCAM cell;

- enabling the current sources to establish conducting paths from Vdd to the match line and the dummy line and pull the potential of the match line and the dummy line to a level less than half Vdd;

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disabling the current sources to shut off the conducting paths from Vdd to the match line and the dummy line; and

enabling the sense amplifier to sense the voltage difference between the match line and the dummy line and determine the match or the mismatch state, finishing one comparison cycle.

9. The TCAM of claim 1, wherein the match line and the dummy line in each row are connected to ground through respective N type transistors.--

Allowable Subject Matter

5. Claims 1-9 are allowed.

The record of the prosecution as a whole makes clear the reasons for the indication of allowable subject matter.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jung (John) Hur whose telephone number is (571) 272-1870.

The examiner can normally be reached on M-F 6:30 AM - 3:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms can be reached on (571) 272-1869. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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